# Alignment of Klaus in Mount Wilson

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# BiSON Birmingham Solar-Oscillations Network

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**Abstract**

The Pockels cell was emptied and refilled, all optics cleaned and aligned, a failing hard disk drive replaced, and the GPS repaired.

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## 1 Introduction

Steven Hale visited Mount Wilson between 2008 May 12 and May 19. The main tasks that were planned for this trip were:

- Clean and align all optics.
- Replace a faulty hard disk.
- Refill the Pockels Cell.
- Fix the GPS.

# 2 Clean and Align All Optics

There are five mirrors in the system in front of Klaus.

The first two are the cœlostat mirrors. They direct the beam vertically down through the sixty-foot tower. It was not possible to clean these two mirrors on this trip due to the lack of a nitrogen cylinder required to dry the surface after cleaning. This will be done at a later date.

About twenty feet from the bottom of the tower, there are two "periscope" mirrors, oriented at 45° to the vertical. They pick off a small part of the beam. The first periscope mirror deflects the beam sideways slightly, and the second deflects it down again.

At the bottom of the tower, the beam hits the fifth mirror and is reflected horizontally into Klaus. The final beam alignment is done with this fifth mirror. It is on an altitude/azimuth mount. Two micrometers allow it to be adjusted in the horizontal (azimuth) and the vertical (altitude) direction.

On this trip, the upwards-facing periscope mirror was removed and cleaned. The downwards-facing mirror was not very dirty. When reinstalling the mirror, adjustments were made to the periscope to ensure good alignment with the lower fifth mirror. Both the fifth mirror and the red filter at the front of the instrument were removed and cleaned.

There is a quadrant photodiode at the back of Klaus, and it was intended that this be used as an alignment monitor. Unfortunately the alignment monitor does not work — it doesn't handle the photodiode signals properly and so it can't actually be used to check the alignment.

There are two methods for checking how well the spectrometer is aligned with the fifth mirror. The first is by visually observing the path of the light within the instrument. For this to work the interference filter has to be removed in order to be able to see the beam. It is then possible to compare the position of the beam with the center of the lenses within the spectrometer, and also check for vignetting on the quadrant at the back of the instrument. The second method is more quantitative and usually more precise. This involves gradually stepping the mirror using the micrometers, one axis at a time, and plotting the effects on the data. It is then possible to determine from the graph the micrometer values that give the best data quality.

Both of these were done on a previous trip [1], with the visual method used to achieve basic alignment, and then the mirror scan to fine tune. However, the data quality were still not very good. The intensity profile was poor. The sum would rise during the morning and fall during the afternoon, rather than being flat throughout the day as with our other sites.

It seems that the best position indicated by the mirror scan results in some vignetting when observing the beam at the back of the instrument. Therefore on this trip spectrometer alignment was done using purely the visual method to ensure no vignetting occurred within the instrument, and no mirror scan was performed. The resulting data look much better. The sum is not totally flat, but it is greatly improved. The afternoon data are worse than the morning, but this is expected due to the additional haze caused by looking out over Los Angeles in the afternoon.

All cleaning and alignment was completed by 2230 on 2008 May 15.

The cleaning resulted in an increase in intensity of a few thousand counts. At our other sites such cleaning usually results in a jump in intensity of a significant percentage of the total signal. However in Mount Wilson the instrument is safely hidden away and so does not get as dirty — the cœlostat mirrors take the brunt of the weather.

# 3 Replace Faulty Hard Disk

The master hard disk on the secondary IDE controller in the PC was showing signs of imminent failure. The monthly SMART scan would show up bad sectors on the disk. As a preventative measure the disk was replaced before it failed completely.

# 4 Refill the Pockels Cell

Some of the index matching fluid in the Pockel's cell had gone missing. There were no signs of the fluid having leaked, so where it goes remains a mystery. The cell was topped up, but the new fluid did not mix with the old and remained in two separate layers.

This meant that the cell had to be removed from the instrument by disconnecting the two SHVs in the connections box at the back, and all the fluid drained. The easiest way was to unscrew the front cover of the cell, marked "Do Not Open". With all the old liquid removed the cell was reassembled, refilled using just the new liquid, and reinstalled in the instrument.

The fluid used to fill the cell is known as Immersion Oil and supplied by Sigma-Aldrich. The liquid specification is shown in table 1.

**Table 1**: Immersion oil properties.

| | |
|---|---|
| Product Number | 51786-250ML |
| Product Line | BioChemika |
| Refractive Index | n20/D 1.517 |
| Viscosity | 30-60 mPa.s (20°C) |
| Density | 1.060 g/mL at 20°C |
| Hazard Codes | Xi |
| Risk Statements | 36/37/38 |
| Safety Statements | 26 |

# 5 Fix the GPS

The GPS unit in Mt. Wilson has not worked for some time.

The cable from the GPS was traced outside towards the antenna. The fault was obvious. The antenna was no longer actually connected to the cable because the crimp on the BNC had failed.

A short section was cut from the antenna cable to remove some weather damage, and a new BNC crimped onto the end. The cable has now been cable tied to the building to take any strain off the connections, so hopefully the problem should not occur again.

The GPS started to work again as soon as the antenna was reconnected.

# 6 UPS

Shortly after a previous trip [1], Perry Rose bought a UPS for the main instrument in the sixty-foot tower. Since it had more than enough capacity, all of our electronics were moved over onto the UPS as well.

At some time in between then and now, the UPS failed. It was not replaced. So now none of our hardware is UPS protected any more.

# References

[1] Steven J. Hale. Alignment of Klaus in Mount Wilson. *BISON Technical Report Series,* Number 292, High-Resolution Optical-Spectroscopy Group, Birmingham, United Kingdom, August 2007.